IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re:	Mark E. Kuznetsov	Confirmation No:	2975
Serial No:	10/683,979	Group:	2163
Filed:	October 10, 2003	Examiner:	Vy, Hung T.
For:	Optical Resonator With Mirror Structure Suppressing Higher Order Transverse Modes		
Customer No.:	25263		
Attorney Docket No.	1058US2		

APPELLANT'S BRIEF

FACSIMILE: **571-273-8300**
Mail Stop Appeal Brief- Patents
Commissioner for Patents
P.O. Box 1450,
Alexandria, Virginia 22313-1450

Sir:

This is the Applicants' appeal from the final Office Action, mailed may 24, 2006 (Paper No. 20060421).

A one-month extension of time is requested for this response.

Real Party in Interest

Axsun Technologies, Inc. is the real party in interest.

Related Appeals and Interferences

There are no related appeals or interferences.

Status of Claims

Claims 12-19, 28 and 29 are pending in the application.

Claims 1-11 and 20-27 were cancelled.

Claims 12-19, 28, and 29 have been rejected and the rejections thereof are being hereby appealed.

Status of Amendments

All amendments have been entered. There were no post final amendments or proposed amendments.

Summary of Claimed Subject Matter

The present invention concerns an optical resonator comprising at least one optical cavity defined by at least two mirror structures. This resonator is described for example on page 24, paragraph [133] of the instant specification as filed (hereinafter Specification) and in Fig. 19 showing mirrors 210, 212 defining a resonator cavity 200.

At least one of the mirror structures 212 has a mirror profile characterized by a sag d_0 and a diameter w. Specification on page 24, paragraph [133]. The cavity also has a length.L_c. See Fig. 19.

According to claim 12, the diameter and the sag are selected in combination with the length of the cavity to degrade a stability of transverse modes with mode numbers 4 and greater. This is capability is understood by observing how mode intensity is distributed in Hermite-Gaussian transverse modes of spherical mirror resonators, shown in Fig. 2. The higher order modes have a greater lateral extent. To be overly simplistic, the present invention works by using a mirror with a small diameter and low sag, in combination with cavity length, so that higher order modes do not "fit" in the mirror. They thus become unstable. Specification on page 15, paragraph [90]. Claim 29 has similar features.

Claim 13 describes specific dimensions for the resonator: optical cavity is less than about 50 micrometers, the sag of the mirror profile is less than about 200 nanometers, and a full width at half maximum diameter of the mirror profile is less than 30 micrometers.

Claim 14 describes more specific dimensions for the resonator: the length of the optical cavity is less than about 30 micrometers, the sag of the mirror profile is less than about 150 nanometers, and a full width at half maximum diameter of the mirror profile is less than 20 micrometers.

Claim 15 describes still more specific dimensions for the resonator: the length of the optical cavity is less than about 20 micrometers, the sag of the mirror profile is less than about 100 nanometers, and a full width at half maximum diameter of the mirror profile is less than 15 micrometers.

Claims 16 and 17 provide specific sag dimensions of 150 nanometers and 100 nanometers, respectively.

Grounds of Rejection to be Reviewed on Appeal

First Ground of Rejection: Whether claims 12-19 and 28 are unpatentable over claims of copending Application No. 10/909,108 under the judicially created doctrine of obviousness-type double patenting. Applicant requests to defer this matter until the status of the 10/909,108 application is determined.

Second Ground of Rejection: Whether claims 12, 18-19 and 28 are unpatentable under 35 U.S.C. 102(b) as being anticipated by Hendow *et al.* (U.S. Patent No. 5,418,641).

Third Ground of Rejection: Whether claims 12 and 28 are unpatentable under 35 U.S.C. 102(b) as being anticipated by Baird *et al.* (U.S. Patent No. 5,317,447).

Fourth Ground of Rejection: Whether claims 13-17 are unpatentable under 35 U.S.C. 103(a) as being obvious over Baird *et al.* (U.S. Patent No. 5,317,447) or Hendow *et al.* (U.S. Patent No. 5,418,641).

Argument

I. Arguments to the First Ground of Rejection of claims 12-19 and 28 as being provisionally unpatentable over claims of copending Application No. 10/909,108 under the judicially created doctrine of obviousness-type double patenting.

This rejection is moot since the 10/909,108 application is no longer pending.

II. Arguments to the Second Ground of Rejection of claims 12, 18-19 and 28 under 35 U.S.C. 102(b) as being anticipated by Hendow *et al.* (U.S. Patent No. 5,418,641).

Claims 12 and 29 require diameter and sag that are selected in combination with a length of the cavity to degrade a stability of transverse modes with mode numbers 4 and greater.

This functionality is not shown or described by the Hendow Patent.

In fact, the Hendow Patent takes a different approach to minimizing the impact of the higher order modes. Specifically, the Hendow Patent teaches an approach whereby the modes are positioned to spectrally overlap. For example, from column 2, of the Hendow Patent:

> The invention resides in methods of minimizing the effect of transverse modes of a Fabry-Perot optical resonant cavity of a type having families of such transverse modes between longitudinal TEM_{00} modes. The invention according to this aspect thereof merges the families of transverse modes into the longitudinal TEM_{00} modes of the non-confocal Fabry-Perot optical resonant cavity.

In short, Hendow seeks to spectrally combine the higher order modes into the lower order mode, rather than 'degrade their stability,' as claimed.

Claim 18 requires that the optical distance between the mirrors is tunable.

The Hendow Patent does not disclose a tunable Fabry-Perot cavity.

The pending Office Action argued that column 8, lines 5-25 of the Hendow Patent disclosed a tunable cavity:

> ten micron range. By way of example, a typical cavity in that range may be $L=10\ \mu m$, and a corresponding cavity bandwidth may be $\Delta v=15$ GHz.
>
> Pursuant to Equation (4) this yields a Free Spectral Range of FSR=15,000 GHz. Pursuant to Equation (3) the cavity finesse then is F=1,000.
>
> For a collapsing of three transverse modes (m=3), Equation (5) then provides a radius of curvature for each mirror 18 and 19 of R being at least 73 meters. In practice that radius may be more than 73 meters, but, the fact that the cavity 17 is said to be a spherical mirror cavity implies that the radius of curvature R has to be less than infinity, or the cavity would be a pure flat-mirror cavity beyond the scope of the invention.
>
> By way of further example, the radius of spherical mirror curvature R has to be more than 15 meters for a cavity optical paths length L of 50 μm, a bandwidth Δv of 15 GHz, and a finesse F of 200.
>
> Pursuant to another example, the radius of mirror curvature has to be more than 16.5 meters, for a cavity

Tunability is not mentioned in this portion of the Hendow Patent.

Claim 19 further requires that tunability is provided by "out-of-plane deflection of one of the mirror structures."

The Hendow does not mention tunability or tunability by mirror deflection as claimed.

Claim 28 requires a "profile of the mirror structures is concave in a center region surrounding an optical axis and flat and/or convex in an annular region surrounding the center region." Such a shaped mirror structure is not shown by the Hendow Patent.

Thus, these rejections should be withdrawn

III. Arguments to the Third Ground of Rejection of claims 12 and 28 under 35 U.S.C. 102(b) as being anticipated by Baird *et al.* (U.S. Patent No. 5,317,447).

Claim 12 requires a diameter and sag that are selected in combination with a length of the cavity to degrade a stability of transverse modes with mode numbers 4 and greater.

This functionality is not shown or described by the Baird Patent. The pending Office Action cited the following portion of column 10 for the features of claim 12:

> The radii of curvature are chosen in conjunction with cavity length 18 and the geometry of lasant 80 to provide a resonator mode beam waist or radius waist that permits low threshold laser operation. In the preferred embodiment, resonator mirror 108 has a radius of curvature of 100 mm, and output coupling mirror 120 has a radius of curvature 20 mm. Lasant 80 has a length of about 5 mm and has a rectangular cross section of 4 mm×5 mm. A TEM_{00} mode radius waist of less than 40 μm is located within lasant mode volume 76 near lasant surface 112. Optical pumping beam 74 is focused to have a beam radius well-matched to the TEM_{00} mode radius throughout lasant mode volume 76.

This portion of the Baird Patent merely teaches that the lowest order mode is focused to have a waist within the gain medium. There is no suggestion to degrade the stability of certain higher order modes as claimed.

Claim 28 requires a "profile of the mirror structures is concave in a center region surrounding an optical axis and flat and/or convex in an annular region surrounding the center region." Such a shaped mirror structure is not shown by the Baird Patent.

Thus, these rejections should be withdrawn

IV. Arguments to the Fourth Ground of Rejection of claims 13-17 under 35 U.S.C. 103(a) as being obvious over Baird *et al.* (U.S. Patent No. 5,317,447) or Hendow *et al.* (U.s. Patent No. 5,418,641).

Claims 13-17 disclose specific combinations of cavity lengths, mirror sag, and diameter. For example, broadest claim 13 provides for an optical cavity that is less than about 50 micrometers, a sag of the mirror profile that is less than about 200 nanometers, and a full width at half maximum diameter of the mirror profile is less than 30 micrometers.

Neither of the applied reference discloses cavities within these claimed parameters.

The pending Action argues that these ranges are obvious from the references. In reality, the references describe different parameters. For example, the Baird Patent uses longer cavities. The Baird lasant 80 alone is 5 millimeters long, much greater than the claimed 50 micrometers. Neither patent even recognizes the importance of the claimed sag and diameter parameters.

Thus, there is no evidence that one skilled in the art at the time of the invention would have thought to even consider optimizing the sag and mirror diameters to control higher order modes as claimed.

For the foregoing reasons, Applicant believes that the pending rejections should be withdrawn, and that the present application should be passed to issue. Should any questions arise, please contact the undersigned.

Respectfully submitted,

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Claims Appendix

1. (Cancelled)

2. (Cancelled)

3. (Cancelled)

4. (Cancelled)

5. (Cancelled)

6. (Cancelled)

7. (Cancelled)

8. (Cancelled)

9. (Cancelled)

10. (Cancelled)

11. (Cancelled)

12. (Original) An optical resonator comprising at least one optical cavity defined by at least two mirror structures in which at least one of the mirror structures has a mirror profile having a diameter and sag that are selected in combination with a length of the cavity to degrade a stability of transverse modes with mode numbers 4 and greater.

13. (Original) A resonator as claimed in claim 12, wherein the length of the optical cavity is less than about 50 micrometers, the sag of the mirror profile is less than about 200 nanometers, and a full width at half maximum diameter of the mirror profile is less than 30 micrometers.

14. (Original) A resonator as claimed in claim 12, wherein the length of the optical cavity is less than about 30 micrometers, the sag of the mirror profile is less than about 150 nanometers, and a full width at half maximum diameter of the mirror profile is less than 20 micrometers.

15. (Original) A resonator as claimed in claim 12, wherein the length of the optical cavity is less than about 20 micrometers, the sag of the mirror profile is less than about 100 nanometers, and a full width at half maximum diameter of the mirror profile is less than 15 micrometers.

16. (Original) A resonator as claimed in claim 12, wherein the sag of the mirror profile is less than about 150 nanometers.

17. (Original) A resonator as claimed in claim 12, wherein the sag of the mirror profile is less than about 100 nanometers.

18. (Original) A resonator as claimed in claim 12, wherein an optical distance between the mirror structures is tunable.

19. (Original) A resonator as claimed in claim 12, wherein an optical distance between the mirror structures is tunable by out-of-plane deflection of one of the mirror structures.

20. (Cancelled)

21. (Cancelled)

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

25. (Cancelled)

26. (Cancelled)

27. (Cancelled)

28. (Previously presented) A resonator as claimed in claim 12, wherein a net profile of the mirror structures is concave in a center region surrounding an optical axis and flat and/or convex in an annular region surrounding the center region, and wherein the diameter and sag of the center region degrades the stability of transverse modes with mode numbers 4 and greater.

29. (Previously presented) An optical resonator comprising at least one optical cavity defined by at least two mirror structures in which at least one of the mirror structures has a mirror profile having a diameter and sag, wherein the diameter and sag in combination with a length of the cavity degrade a stability of transverse modes with mode numbers 4 and greater.

Evidence Appendix

None

Related Proceedings Appendix

None